Scientists reveal the global reprogramming of 3D chromatin structure during mammalian embryogenesis

With the support by the National Natural Science Foundation of China, a collaborative study by two groups led by Dr. Liu Jiang (刘江) from Beijing Institute of Genomics (BIG), CAS and Dr. Huang Xingxu from Shanghai Tech University reveals the global reprogramming of 3D chromatin structures from mammalian gametes to early embryos, which was published in *Cell* (2017, 170(2): 367—381).

The linear length of human DNA is about 2 meters. However, the nucleus size of a normal human cell is only about 5 — 10 micrometers. Therefore, DNA has been properly folded to facilitate gene expression in human nuclei. The lives of most of animals start from the fertilization of sperm and oocytes. Mammalian sperm DNA is highly packed with protamine, and the size of the sperm nucleus is about 1/10 of that of the normal cell nucleus. Mature oocyte is paused at metaphase II state, and oocyte chromatins are tightly packed and arrested at the spindle plate. Until now, it remains unknown how the tightly packed patterns of gamete chromatins are changed to a loose pattern in early embryos through development.

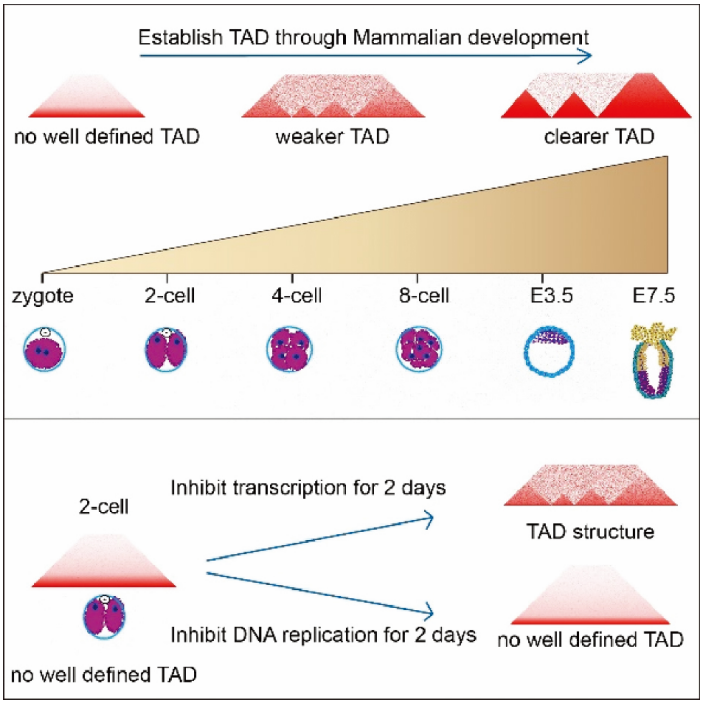

Figure 3D chromatin structures undergo global reprogramming during embryo development. The establishment of TAD requires DNA replication, but not zygotic genome activation.

The scientists generated 3D chromatin architectures of mouse gametes and early embryos. They have found that mature oocytes at the metaphase II stage do not have topologically associated domains (TADs). In sperm, extra-long-range interactions (>4 megabases) and interchromosomal interactions occur frequently. The high-order structures of both the paternal and maternal genomes in zygotes and 2-cell embryos are obscure, but are gradually re-established through development. In addition, they have demonstrated that the establishment of the TAD structure requires DNA replication, but not zygotic genome activation. Their work also provides a valuable data resource for the study of mammalian embryonic development.